Pilot Testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems

Quarterly Technical Progress Report

October 1, 2001 – December 31, 2001

Cooperative Agreement No: DE-FC26-01NT41185

Prepared for:

Bruce Lani

National Energy Technology Laboratory
U.S. Department of Energy
626 Cochrans Mill Road
Pittsburgh, Pennsylvania 15236

Prepared by:

Gary M. Blythe

URS Corporation
9400 Amberglen Boulevard
Austin, Texas 78729

February 22, 2002

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Abstract

This document summarizes progress on Cooperative Agreement DE-FC26-01NT41185, Pilot Testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems, during the time period October 1, 2001 through December 31, 2001. The objective of this project is to demonstrate at pilot scale the use of solid honeycomb catalysts to promote the oxidation of elemental mercury in the flue gas from coal combustion. The project is being funded by the U.S. DOE National Energy Technology Laboratory under Cooperative Agreement DE-FC26-01NT41185. EPRI, Great River Energy (GRE), and City Public Service (CPS) of San Antonio are project co-funders. URS Group is the prime contractor.

The mercury catalytic oxidation process under development uses catalyst materials applied to honeycomb substrates to promote the oxidation of elemental mercury in the flue gas from coal-fired power plants that have wet lime or limestone flue gas desulfurization (FGD) systems. Oxidized mercury is removed in the wet FGD absorbers and co-precipitates in a stable form with the byproducts from the FGD system. The co-precipitated mercury does not appear to adversely affect the disposal or reuse properties of the FGD byproduct. The current project will test previously identified, effective catalyst materials at a larger, pilot scale and in a commercial form, so as to provide engineering data for future full-scale designs. The pilot-scale tests will continue for up to 14 months at each of two sites to provide longer-term catalyst life data.

This is the first full reporting period for the subject Cooperative Agreement. During this period, most of the project efforts were related to project initiation and planning. There is no significant technical progress to report for the current period.

TABLE OF CONTENTS

Page

1.0 Introduction

This document is the semi-annual Technical Progress Report for the project "Pilot Testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems," for the time period October 1, 2001 through December 31, 2001. The objective of this project is to demonstrate at pilot scale the use of solid honeycomb catalysts to promote the oxidation of elemental mercury in the flue gas from coal combustion. The project is being funded by the U.S. DOE National Energy Technology Laboratory under Cooperative Agreement DE-FC26-01NT41185. EPRI, Great River Energy (GRE) and City Public Service (CPS) of San Antonio are project co-funders. URS Group is the prime contractor.

The mercury catalytic oxidation process under development uses catalyst materials applied to honeycomb substrates to promote the oxidation of elemental mercury in the flue gas from coal-fired power plants that have wet lime or limestone flue gas desulfurization (FGD) systems. The oxidizing species are already present in the flue gas, and may include chlorine, hydrochloric acid (HCl) and/or other species. Oxidized mercury is removed in the wet FGD absorbers and co-precipitates in a stable form with the byproducts from the FGD system. The co-precipitated mercury does not appear to adversely affect the disposal or reuse properties of the FGD byproduct.

The objective of the current project is to test previously identified, effective catalyst materials at a larger scale and in a commercial form, so as to provide engineering data for future full-scale designs. The pilot-scale tests will continue for up to 14 months at each of two sites to provide longer-term catalyst life data.

Based on information from the U.S. EPA Mercury Information Collection Request (ICR), the technology under development is probably best suited for plants with a high-efficiency particulate control device upstream of the FGD system, rather than systems that use high-energy scrubbers to achieve combined particulate and SO_2 control. The former represents the majority of FGD systems in the U.S., about 90,000 MW of generating capacity. The ICR results also suggest that catalytic oxidation of elemental mercury would have the greatest effect on the flue gas from subbituminous coal or lignite, where most of the mercury is present in the elemental form. There are approximately 28,000 MW of scrubbed capacity firing these fuels with more systems planned.

The two utility team members are providing co-funding, technical input, and host sites for testing. GRE will host the first test site at their Coal Creek Station (CCS), which fires a North Dakota lignite, and CPS will host the second site at their J.K. Spruce Plant, which fires a Powder River Basin (PRB) subbituminous coal. These two host sites each have existing wet FGD systems downstream of high-efficiency particulate control devices, an ESP at CCS and a reverse-gas fabric filter at Spruce. Each has been measured to contain substantial concentrations of elemental mercury in their flue gas.

After successful completion of the project, it is expected that sufficient full-scale test data will be available to design and implement demonstration-scale or commercial-scale installations of the catalytic mercury oxidation technology.

The remainder of this report is divided into three sections**.** Section 2 provides an account of progress on the project during the current reporting period, including any problems encountered. Section 3 provides a forecast of plans for the next and future reporting periods, and Section 4 provides a detailed discussion of technical results from the project during the current reporting period (although there are none for this early period).

2.0 Progress during the Current Reporting Period

2.1 Summary of Progress

The current reporting period, October 1, 2001 through December 31, 2001, is the first full technical progress reporting period, as August 30, 2001 was the start date for the Cooperative Agreement. Most of the efforts over this period were related to project planning and initiation, including holding a project kickoff meeting, preparing an initial test plan, and beginning the design of the pilot oxidation system required to conduct the planned tests. No testing was conducted during this reporting period.

A project kickoff meeting was held on November 27, 2001, at the NETL Bruceton facility. Representatives from DOE and from project team members URS Group and EPRI were in attendance. No significant changes to the proposed project approach were made as an outcome of the meeting**.**

After the project kickoff meeting was conducted, a draft Test Plan for the project was prepared and distributed to other team members for review. This Test Plan will be submitted to DOE in the first quarter of calendar year 2002. Also, after the project kickoff meeting, a detailed design effort was begun for the pilot-scale catalyst test unit. The detailed design will be completed in the first quarter of calendar year 2002.

No subcontracts were awarded during the current reporting period.

2.2 Problems Encountered

There were no significant problems encountered during the reporting period.

3.0 Plans for Future Reporting Periods

3.1 Plans for Next Reporting Period

The next reporting period covers the time period January 1 through March 31, 2002. The plans for that period are to submit a Test Plan to DOE for review, to complete the pilot unit detailed design, select a subcontractor for the pilot unit fabrication, and begin fabrication. The instrumentation, controls, and valves for the pilot unit will be specified and procured during the period, for installation by the fabrication subcontractor. Also during the period, site visit/kickoff meetings will be made at Host Site 1 (GRE's CCS) and Host Site 2 (CPS' Spruce Plant). Finally, samples of candidate catalyst materials for the 14-month test at Site 1 will be procured and tested in the laboratory. These results will be used to select four catalysts with the highest mercury oxidation activity at simulated CCS flue gas conditions and to determine the amount of each catalyst that will be required to charge the pilot reactors.

3.2 Prospects for Future Progress

During the subsequent reporting period (April 1 through June 30, 2002), it is expected that the mercury oxidation pilot unit will be completed and shipped to GRE's CCS plant, installed, and started up. Four catalyst materials will be procured in sufficient quantity to ensure high elemental mercury oxidation (greater than 95%) at test beginning and installed in the pilot unit. Once the catalyst material has been installed and operated in flue gas long enough to achieve mercury adsorption equilibrium (approximately one to two weeks), an initial host site flue gas characterization effort and catalyst performance evaluation test will be conducted**.**

In later reporting periods (July 1 through September 30, 2002 and October 1 through December 31, 2002), it is anticipated that the pilot unit will remain in operation at CCS and will be evaluated for elemental mercury oxidation performance through routine monthly evaluation trips.

4.0 Technical Results

There are no technical results to report for the current reporting period (October 1, 2001 through December 31, 2001).